This invention relates to a rotary cleaning device for cleaning the surface of an object by means of friction with or without the aid of a suitable liquid. While the invention is widely applicable for its purpose, it has been initially embodied in a rotary assembly to perform the function of a conventional rotary brush for washing automobiles. This particular practice of the invention has been selected for the present disclosure and will provide adequate guidance for those skilled in the art who may wish to apply to the same principles to other specific purposes.

A conventional bristle-type rotary car washing brush serves its purpose effectively but nevertheless has certain disadvantages. One disadvantage is the relatively high cost of a bristle-type rotary brush. A closely related disadvantage is that such a brush has a limited service life over which the high initial cost must be absorbed.

Another disadvantage is that the necessity of firmly securing the roots of the bristles makes it necessary to employ a relatively heavy mandrel or core structure. As a result, such a rotary brush has relatively high inertia. Inertia is an important consideration because the brush operates intermittently and commonly starts and stops two or three times a minute continuously throughout a day of normal operation. The consequent heavy starting load repeatedly imposed on the motor causes trouble and costly maintenance in operation.

A still further disadvantage of a bristle-type rotary car washing brush is that it may damage external devices that commonly protrude from automobile bodies. Only too often rearview mirrors mounted on the sides of automobile bodies are broken loose by rotary bristle-type brushes.

It has also been found necessary to keep a conventional rotary bristle-type brush away from an automobile antenna lest such a brush become entangled with the antenna by wrapping action, pull the antenna loose, and then whip the car with the antenna. Because of these hazards, conventional rotary brushes commonly contact only portions of the side mirrors and tops of automobiles, hand washing being necessary in the regions of side mirrors and in regions that are aligned with antennas.

The present invention is based on the concept of substituting a body of cellular plastic for the usual bristles of such a rotary brush. It has been found that this substitution results in unexpected advantages provided that the cellular plastic meets certain requirements.

The cellular plastic must be flexible to conform to car bodies of different configurations. The cellular plastic must also be soft and non-abrasive to avoid damage to the automobile surfaces. For an adequate cleaning action to remove tenacious dirt particles, the cellular plastic should have a relatively high coefficient of friction. The rotary cellular plastic should cover effectively whatever width of a car body it spans.

For use with water jets in the usual manner, the cellular plastic must be permeable to liquid and capable of holding a substantial quantity of liquid. On the other hand, for low inertia, the cellular plastic should have low density and should not hold too much liquid. For holding just the right amount of liquid, it has been found that the cells of the plastic should be open to receive liquid but the walls of cells themselves should not be absorbent.

For economy, the cellular plastic must be relatively inexpensive and be durable to provide a long service life.

For durability, the cellular plastic material must be inert to withstand solvents and detergents. It must have adequate cohesion and tensile strength to withstand centrifugal forces when heavily loaded with liquid. It must be wear-resistant to withstand continuous peripheral friction.

Many cellular plastics have been considered but found wanting. For example, the material used for common cellular sponges is of open construction but absorbs too much liquid because the walls of the cells absorb water. Sponge rubber meets some of the requirements but is ruled out because it deteriorates rapidly by crumbling away when subjected to high speed friction.

The material that has been found to be completely satisfactory is cellular polyurethane, commonly called urethane foam. A suitable grade for the present purpose weighs approximately 3.8 pounds per cubic foot, is of open cell construction with non-absorbent cell walls and is capable of holding approximately three and one-half times its weight in water under static conditions. A lighter grade weighing only two pounds per cubic foot can be used, but preferably is subjected to a temperature of 400 °F. for one minute for greatly increased resiliency and tensile strength.

Urethane foam has such a high coefficient of friction that it is commonly used under throw rugs to prevent slippage. Urethane foam is also quite inexpensive compared to conventional bristle-type rotary brushes. It is invulnerable to solvents and detergents. It has high cohesion and tensile strength to withstand the centrifugal forces created in car washing operations. It is so wear-resistant that it will far outlast any bristle-type rotary brush.

A further important discovery is that a relatively thin rotating disk of urethane foam floats in a desirable manner when pressed edgewise against a surface. This floating action may be augmented by cementing the urethane foam disk to a position slightly out of perpendicular to the axis of rotation. The floating action causes the rotating disk to rub an area that is of substantially greater width than the thickness of the disk. Apparently the fluctuation of the marginal portion results from an unstable conflict of opposing forces, including centrifugal force.

One advantage of the fluctuating action is the added optional cleaning action. Another advantage is that the floating action throws dislodged dirt particles away from the cleaning zone.

Since a relatively thin disk of urethane foam cleans a surface wider than its thickness, a gang or stack of the disks with liberal spacing between the disks may be employed for thorough coverage of a surface as wide as the axial dimension of the stack of disks. The spacing of the successive disks lightens the rotary assembly. The aggregate weight of the rotary assembly is so low that starting torque is no longer a problem even when the urethane foam is loaded with its maximum quantity of liquid.

In a rotary assembly of stacked urethane foam disks with liberal spacing between the individual disks, the disks readily flex to pass around protruberances on automobile bodies, such as door handles, side mirrors and the like. The urethane foam is so soft, especially when wet, that it exerts exceedingly low resistance to flexure and is incapable of causing mechanical injury. A rotary urethane foam assembly of this character may be used safely in the region of automobile antennas since the character of the foamed plastic and the configuration of the assembly with the spacing between disks makes it practically impossible for an antenna to become entangled by the assembly. For the first time, it becomes possible to use an arrangement of rotary car washing assemblies that completely span the exterior surface of a car body. In such an arrangement, a horizontal overhead rotary
brush assembly covers the full width of the car top and upright rotary washing assemblies on opposite sides of the car cover side zones that extend over the full height of the car and actually overlap the top zone.

The features and advantages of the invention may be understood by reference to the following detailed description together with the accompanying drawings.

In the drawing, which is to be regarded as merely illustrative:

FIG. 1 is a side elevational view of a rotary assembly of foam plastic disks in operation cleaning the side of an automobile.

FIG. 2 is a diagrammatic side elevational view illustrating one manner in which a foam plastic disk may fluctuate when forced edgewise against an object, the surface of which is to be cleaned;

FIG. 3 is a similar view showing another manner in which a foam plastic disk may fluctuate; and

FIG. 4 is a fragmentary side elevational view showing how the foamed plastic disks of an assembly may be canted away from positions normal to the axis of rotation of the assembly to favor or augment the desired fluctuating action.

FIG. 1 shows a rotary assembly embodying the present invention for washing the side of an automobile as the automobile advances downward the length of a wash rack.

In a well-known manner, the rotary assembly is carried by a pivotally mounted yoke having an upper arm 10 and a lower arm 12. The rotary assembly is suitably journaled into the ends of the two arms 10 and 12 and is power driven in a well-known manner by transmission means concealed in one of the two arms. In a well-known manner, the yoke having the two arms 10 and 12 retracts laterally and towards and away from said object, and a plurality of circumferential webs of flexible foamed

When the rotary assembly is pressed against the side of an automobile in the presence of the detergent, the various disks may fluctuate in the manner shown in FIG. 2. In FIG. 2, the disk is flexed by edgewise pressure against the surface 26 and as it rotates it fluctuates in the manner indicated, all of the fluctuation occurring on one side of the plane of the disk. A disk may also fluctuate in the manner indicated in FIG. 3, the range of oscillation of the margin of the disk extending in both directions from the plane of rotation of the disk. By virtue of such fluctuating action, the periphery of each disk wipes the automobile over a zone which is substantially wider than the thickness of the disk.

It is because a disk tends to wipe a zone wider than its own thickness that the disks may be spaced apart in the rotary assembly by spacer collars without leaving any gaps in the coverage by the rotary assembly. The rubbing action is effective because of the texture of the foamed plastic, there being adequate friction to remove even tenacious particles in the presence of the detergent. It is a surprising fact that the rotary brush cleans the surface of an automobile so thoroughly and yet is so mild in its frictional contact with the automobile surface that a person may thrust his hand between the rotary assembly and the surface of the car without feeling painful discomfort.

If some protruding object is encountered, the foamed plastic disks of the assembly simply pass on opposite sides of the object. FIG. 1, for example, shows how the disks 22 and 24 flex to pass on opposite sides of a door handle 28. In the same manner, the disks will flex in a yielding manner to avoid damage to a side mirror on the car. A horizontally positioned overhead assembly may be employed in the same manner to clean the top of a car without any danger of the rotary assembly pulling on the radio antenna of a car.

The rotary assembly shown in FIG. 1 is of the same vertical extent as a conventional bristle-type rotary brush that is used for the same purpose. Bristle-type rotary brushes do not extend into the region of the car windscreen primarily because of the likelihood that side mirrors will be damaged. A feature of the invention, however, is that rotary brush assemblies of the character shown in FIG. 1 may be used on opposite sides of the car and may be extended to cover the full height of the sides of the car. A series of upper foamed plastic disks of the assembly washing the side of the car above the rain gutter 30 of the car. A third horizontal rotary assembly may be employed at the same time to cover the roof of the car down to the rain gutter 30 so that the three rotary assemblies completely span the sides and top surfaces of the car.

The third rotary assembly will have its disks spaced apart in the regions of the car antennas.

FIG. 4 shows how a rotary assembly may be equipped with foamed plastic disks 32 separated by spacer collars 34 with the disks canted or inclined away from their planes of rotation. It has been found that canting a foamed plastic disk in this manner is highly conducive of the desired fluctuating action shown in FIGS. 2 and 3 and especially favors the fluctuating action shown in FIG. 3.

Our description in specific detail of the selected practice of the invention will suggest various changes, substitutions and other departures from our disclosure within the spirit and scope of the appended claims.

We claim:

1. A rotary wiper for use with a liquid detergent to clean the side of an automobile body or like object while relative movement occurs between the object and the axis of the rotary wiper for traversing of the object by the rotary wiper, comprising:

- a power driven rotary support means mounted for rotation about an axis spaced from the object, said support means being moveable laterally of its axis towards and away from said object, and
- a plurality of circumferential webs of flexible foamed
plastic mounted on said support means and extending radially outward from said axis in planes nearer to perpendicular than to parallel to said axis, said webs being thin relative to their radial dimension, the radial extent of said webs from said axis being greater than the distance of the object from said axis at the planes of the respective webs to cause marginal portions of the webs to be flexed by the surface of the object, said webs being spaced apart axially to provide spaces between the successive webs to permit flexure of the marginal portion of each web towards and away from the marginal portions of adjacent webs.

said support means being rotated at a rate to create substantial centrifugal force to create pressure by said marginal portions against the object and to cause the marginal portions to flex in a fluctuating manner for wiping action of the marginal portions against the surface of the object laterally to the planes of rotation of the webs.

2. A rotary wiper as set forth in claim 1 in which the diameters of said circumferential webs are on the order of twenty to thirty inches.

3. A rotary wiper as set forth in claim 1 in which the thickness of said circumferential webs is on the order of one and one-half inches.

4. A rotary wiper for use with a liquid detergent to clean the convex surface of an automobile body or like object while relative movement occurs between the object and the axis of the rotary wiper for traversing of the object by the rotary wiper, comprising:

a power driven rotary support means mounted for rotation about an axis spaced from the object, said support means being moveable laterally of its axis towards and away from said object, and

a plurality of circumferential webs of flexible foamed plastic mounted on said support means and extending radially outward from said axis in planes nearer to perpendicular than to parallel to said axis, said webs being thin relative to their radial dimension, the radial extent of said webs from said axis being greater than the distance of the object from said axis at the planes of the respective webs to cause marginal portions of the webs to be flexed by the surface of the object, said webs being spaced apart axially to provide spaces between the successive webs to permit flexure of the marginal portion of each web towards and away from the marginal portions of adjacent webs.

said support means being rotated at a rate to create substantial centrifugal force to create pressure by said marginal portions against the object and to cause the marginal portions to flex in a fluctuating manner for wiping action of the marginal portions against the surface of the object laterally to the planes of rotation of the webs.

said webs differing in radial extent to provide a concave overall profile of the series of webs conforming generally to the convex configuration of the surface of the object, the central webs of said series of circumferential webs being spaced apart by distances at least as great as the thicknesses of the webs.

5. A combination as set forth in claim 4 which includes an additional group of webs at each end of said series, the webs of each of said groups being close together without substantial spacing to reinforce each other.

6. A combination as set forth in claim 4 which includes an additional group of webs at each end of said series, the webs of each of said groups being close together without substantial spacing to reinforce each other, the diameter of said circumferential webs being on the order of 20 to 30 inches and the webs of said series being spaced apart by distances at least as great as the thickness of the webs.

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